TEMPERATURE RECORDS FROM A SMALL CANTERBURY STREAM

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ABSTRACT

Continuous air and water temperature records were obtained for seven consecutive days in each season of one year, from a site in the South Branch of the Waimakariri River, Canterbury. Water temperatures ranged from 9-18°C, and are similar to those recorded in other low altitude New Zealand streams.

INTRODUCTION

The introduction of water classification into New Zealand, i.e. the declaration of minimum quality standards for all natural waters both fresh and saline (Spooner 1973), has necessitated that more information be obtained on the natural range and variation of physical and chemical conditions of our waters. In particular, information is required on water temperature, dissolved oxygen concentration and pH, all of which are employed as indicators of water quality in the classification. In this paper data on water temperature of a small, lowland stream are presented.

Temperature records were obtained as part of an ecological study of the invertebrate fauna of the South Branch of the Waimakariri River carried out between March 1970 and March 1971 (Fowles 1972a). Air and water temperature readings were made on one day each month between 1000 and 1400 h at nine sampling stations, and continuous recordings were made for seven consecutive days in each season. Few other continuous temperature records exist for New Zealand streams, but it has been possible to compare the data obtained in this study with records from the Hinau Stream in the lower North Island (Hopkins 1971), the Opihi River, South Canterbury (Fowles 1972b) and an earlier study on the South Branch (Burnet 1968).

LOCATION

The South Branch arises as seepage from beneath the stopbanks of the Waimakariri River approximately 1.6 km northwest of Harewood International Airport, Christchurch (172°32'E, 43°28'S). The stream flows for nearly 10 km almost parallel to the Waimaka-

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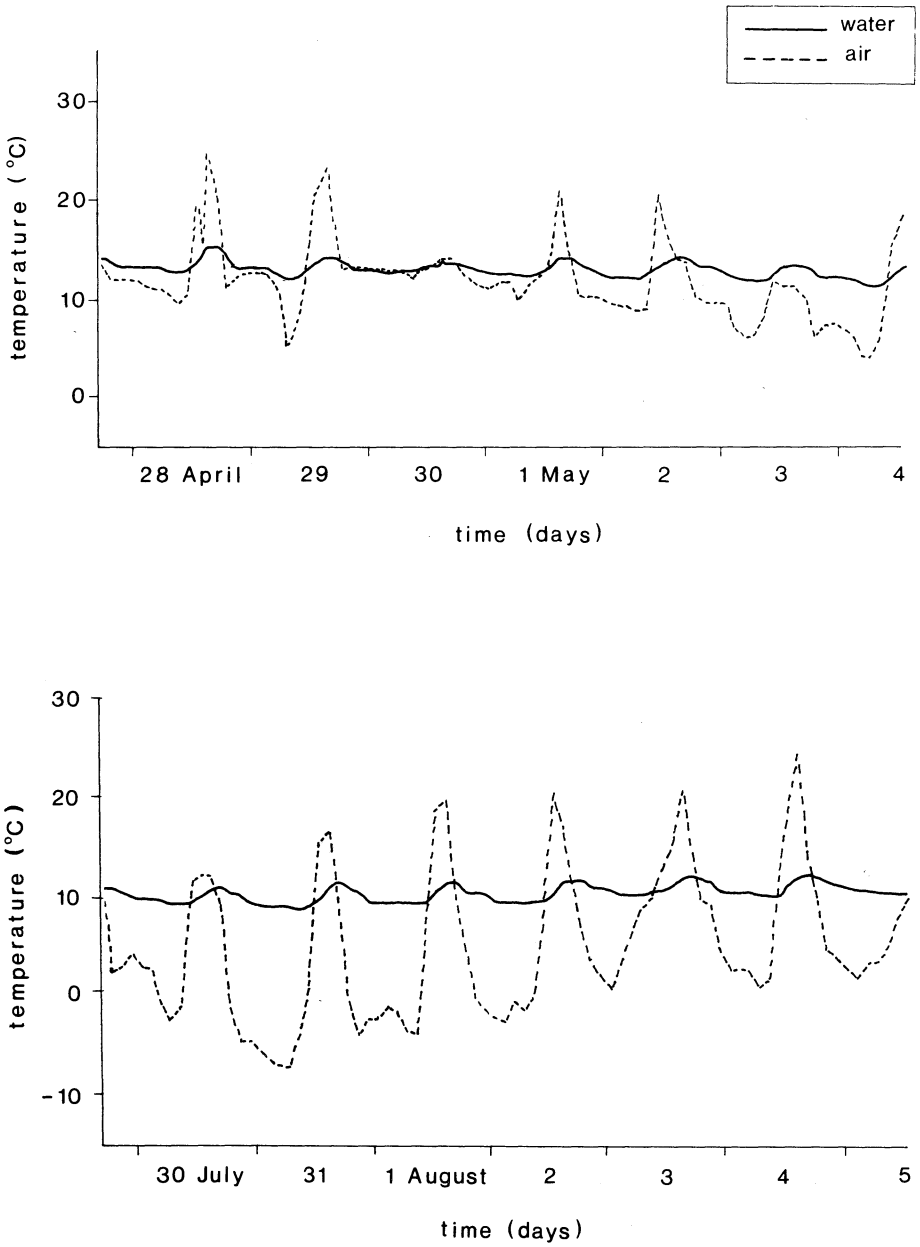
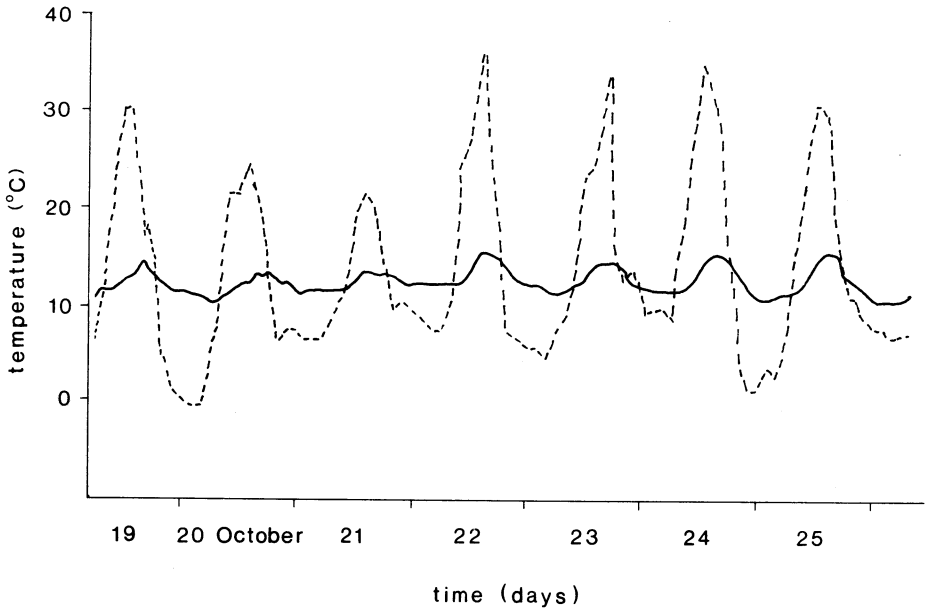


FIGURE 1. Continuous recordings of air and water temperature taken over 7-day periods in autumn 1970, winter 1970, spring 1970 and summer 1971.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temperature (°C)
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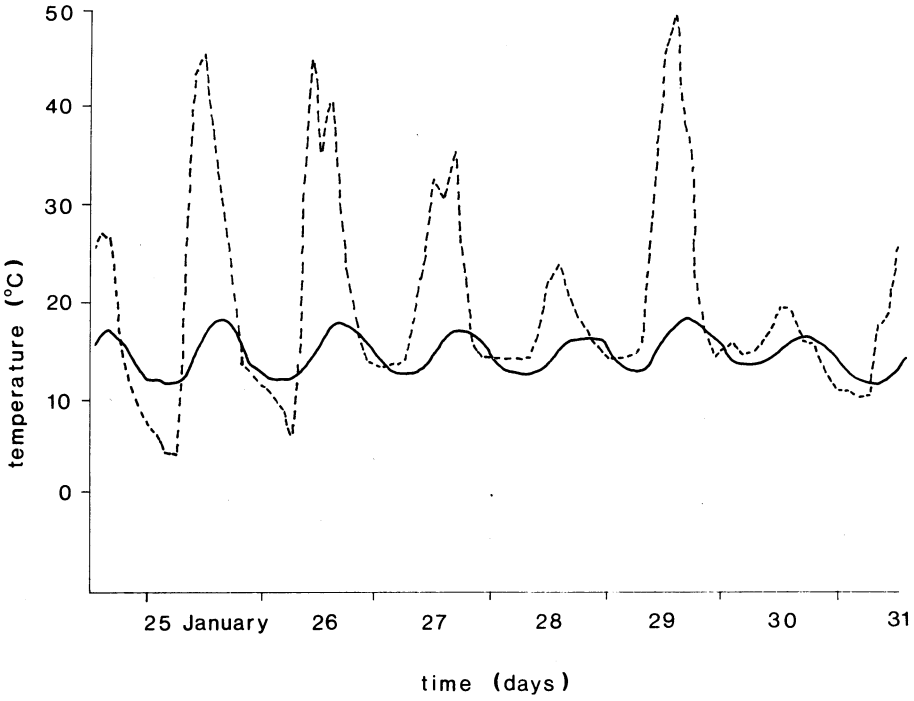
time (days)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riri River before entering the latter almost 6 km from its mouth. All continuous temperature and seasonal oxygen recordings were made at the upstream end of an experimental section of the stream which was approximately 2.5 km long and lay within Messrs F.H. and D. Shipley's "Island Farm" property. This stretch of the South Branch corresponds with Burnet's experimental section (see Burnet 1968, Fig. 1). The recording station was bordered by a grass bank with gorse bushes (*Ulex europeus*) overhanging the stream on the southern side and tall trees and gorse on the northern bank. The trees reduced the amount of incident light reaching the water surface, particularly in winter. Stream width was about 7 m throughout the year, with an average stream depth of 0.25 m and a maximum of nearly 0.4 m. On the southern side of the stream water flowed at about 0.15-0.25 m/s above a pebble bed, but on the northern side extensive weed beds consisting predominantly of *Elodea canadensis* and *Myriophyllum elatinoides* were found. Large amounts of algae including species of *Spirogyra, Oedogonium, Bulbochaete, Microspora, Cocconeis* and *Gomphonema* were attached to the weeds which extended out from the bank up to 3 m and were traversed by short channels of slowly flowing water (0.10 to 0.15 m/s). Beneath the weeds the stream bed consisted of silt and sand. Temperature readings were made also at eight other sites situated along the experimental section. Conditions at these sites were generally similar to those described above although slight differences in substrate, flow conditions, weed bed development and terrestrial plant cover were found.

METHODS

Continuous recordings of water and air temperatures made to the nearest 0.5°C were obtained for 7 day periods in each season, using a 2-probe Cambridge continuous temperature recorder. One probe was positioned on the stream bed and the other immediately above the stream surface. Traces were recorded on calibrated circular graph paper. Dates on which recordings were made were: 27 April-4 May 1970 (autumn); 29 July-5 August 1970 (winter); 19-26 October 1970 (spring); 24-31 January 1971 (summer).

Air and water temperatures were also measured monthly from March 1970 to March 1971 with a hand-held mercury thermometer at nine stations sited along the length of the experimental section. Air temperatures were measured immediately above the surface of the water and water temperatures about 0.1 m beneath the surface. All measurements were made between 1000 and 1400 h.

RESULTS AND DISCUSSION

The continuous temperature recordings obtained in the four seasons are shown in Fig. 1. Wide fluctuations in air temperatures were common because the recording probe, situated immediately above the water surface, was not shielded from direct sunlight. Diel (24 h) fluctuations in air temperature increased from autumn to summer as shown by the maximum ranges over 24 h periods of 17°C in autumn, 25°C in winter, 35°C in spring and 40°C in summer.

Diel water temperature ranges were also greatest in summer (up to 6°C) and lowest in autumn (as low as 1°C). These are greater than the ranges recorded by Hopkins (1971) in the head-

waters of Hinau Stream, a small, spring-fed tributary of the Mangatarere Stream about 65 km northeast of Wellington and nearly 250 m a.s.l. Maximum diel range found in the Hinau (3.0°C) occurred in summer and the minimum range (0.8°C) was recorded in winter. The differences between the two streams can be explained in part by the fact that in Hinau measurements were taken only 300-400 m from the stream source (cf about 2 km in the South Branch), and also because the Hinau was located in a steeper valley and periods of insolation were thus shorter than in the South Branch.

Maximum water temperatures in the South Branch were recorded near mid-afternoon about two hours after maximum air temperature had been reached. Minimum water temperatures usually occurred in the early morning hours during winter, but minima were found nearer mid-morning in summer. This is in agreement with Macan's (1959) results from a small stony stream in the United Kingdom. Maximum temperatures recorded in the Opihi River, South Canterbury during a 12 day period in April 1972 (Fowles 1972b) were reached within an hour of mid-day and minima occurred near dawn. In the mainstream of the Opihi, temperature ranges and means were similar to their seasonal counterparts in the South Branch despite the river being much larger and more open.

The annual temperature range of the South Branch, calculated from the results obtained in the four continuous recording periods was 9°C (9-18°C). An identical range (9-19°C) was recorded by Hopkins (1971) in the Hinau Stream.

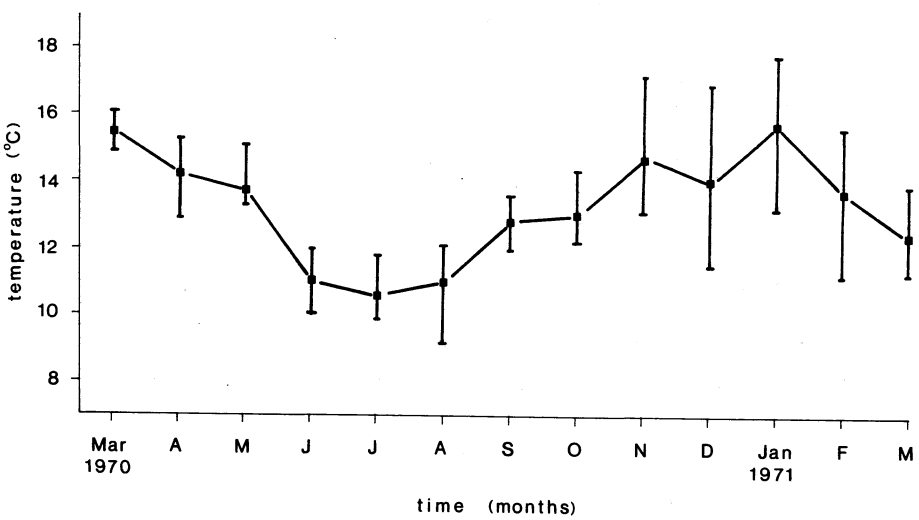

FIGURE 2. Mean and range of water temperatures recorded between 1000-1400 h at 9 stations in the experimental section of the South Branch, March 1970-March 1971.

The means and ranges of water temperatures taken between 1000-1400 h at nine stations on one day per month are shown in Fig. 2. Mean values lay within a range of 5°C (10.5-15.5°C) with extreme values of 9.1 and 17.1°C over the 13-month period. Greatest variation between stations (5.4°C) occurred in December, the highest temperatures being recorded at the downstream stations.

Burnet's (1968) records of water temperature taken with maximum-minimum thermometers in the same section of the South Branch from June 1960 to June 1961 showed a slightly wider annual range (7.8°C to 19.4°C) than that obtained from daytime spot measurements in 1970-71. A very similar range (7.5-19.5°C) has also been recorded by Allen (1951) who measured temperature mainly between 0900 and 1030 h for 12 months in the Horokiwi Stream north of Wellington.

ACKNOWLEDGMENTS

Access to the South Branch was kindly permitted by Mr Dave Shipley, within whose "Island Farm" property the experimental section was situated. Dr M.J. Winterbourn read and criticized the manuscript while Dr V.M. Stout supervised the M.Sc. thesis of which this work formed a part, and maintained an active interest throughout.

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